

**REMARKS/ARGUMENTS**

Reconsideration and re-examination are hereby requested.

In order to advance the prosecution of the patent application applicant has cancelled claims 8, 10, 11, 12 and 13 and has re-written them as new claims 84-88, respectively. For the record applicant respectfully disagrees with the objection and it is applicant's position that the 37 CFR 1.75 (c) applies only to newly or originally filed claims and not to amended claims.

New claims 89 -92 have been added. Such claims point out it that: the method includes: (c) heating the mixing reaction mixture at a constant temperature of between 1700°C and 1900°C for between 10 minutes and 30 minutes while nitrogen gas flows over the mixing reaction mixture to convert the aluminum oxide particles, carbon particles, and nitrogen to aluminum oxynitride; and (d) removing the aluminum oxynitride from the chamber (Claim 89); wherein the mixing reaction mixture provided in step (b) of claim 89 has an initial temperature, the method further comprising heating the mixing reaction mixture to raise the initial temperature from the initial temperature to the constant temperature (Claim 90); wherein the temperature is ramped from the initial temperature to the constant temperature (Claim 91); and wherein the ramp rate is at least 10 degrees C per minute (Claim 92). Support for such claims 89-92 is found on page 6, lines 5 through 8.

Claims 58, 60 and 76 have been amended to have indentations.

With regard to the objection to the specification, while applicant respectfully disagrees with the objection, in order to advance the prosecution of the patent application applicant has deleted the word "subjecting" from the claims having such word.

With regard to the phrase "the entire conversion", while applicant respectfully disagrees with the objection, in order to advance the prosecution of the patent application applicant has deleted the phrase "the entire conversion" from the claims having such phrase.

With regard to the phrase "the temperature" is 1700-1900 C, while applicant respectfully disagrees with the rejection, in order to advance the prosecution of the patent application applicant has changed the phrase to "the temperature is in a range of about 1700-1900°C" for the claims having such phrase.

With regard to the double patenting rejection of claims 33 and 38, reconsideration is hereby requested, it being noted that amendment of claim 32 upon which claim 33 depends has been made in a prior amendment subsequent to the original double patenting rejection made by the Examiner of claim 33 and 38.

With regard to the rejection of claims 8, 10-11, 13 and 32-83 under 35 USC 103(a) as being patentable over Maguire in view of Serpek and optionally in view of Feeco.com webpage on Rotary Kilns:

The Examiner seems to be taking the position that the use of rotary drums may have been used to speed up reactions; but nothing in the Maguire, Serpek, or Feeco.com webpage on Rotary Kilns recognizes that one can ELIMINATE one step of the two step temperature prior art process of step of having to first form AlN and then convert the formed AlN to AlON.

The details of the process described in the Maguire et al patent appear on column 2, beginning at line 36:

... a substantially homogeneous cubic aluminum oxynitride powder by reacting gamma aluminum oxide with carbon in a nitrogen atmosphere. More specifically, aluminum oxide (alumina) and carbon black are dry mixed, for instance, in a Patterson-Kelly twin-shell blender for times up to two hours. Preferably, the aluminum oxide has a purity of at least 99.98% and an average particle size of 0.06 microns, and the carbon black has a purity of no less than 97.6% with 2.4% volatile content and an average particle size of 0.027 microns. The carbon content of the mixture can range from 5.4 to 7.1 weight percent. A preferred mixture comprises 5.6 weight percent carbon black and 94.4 weight percent aluminum oxide. The *aluminum oxide/carbon mixture is placed in an alumina crucible* and is reacted in an atmosphere of flowing nitrogen at temperatures from 1550°C to 1850°C. for up to two hours at the maximum temperature. **The preferred heat treatment is in two steps. In the first step, a temperature of approximately 1550° C. is used for approximately one hour, whereby, for an appropriate ratio of alumina to carbon, the temperature unstable gamma-aluminum oxide is only partially reacted with carbon and nitrogen to form both alpha-aluminum oxide and aluminum nitride. A one hour soak at 1550°C. is sufficient to convert the proper amount of Al<sub>2</sub>O<sub>3</sub> to AlN. In the second step**, a temperature of 1750°C. or up to the solidus temperature of aluminum oxynitride (2140°C.), is used for approximately 40 minutes, whereby alpha-aluminum oxide and aluminum nitride combine to form cubic aluminum oxynitride.

Thus, there are actually **three** steps in the process:

1. A temperature of approximately 1550° C. is used for approximately one hour, whereby, for an appropriate ratio of alumina to carbon, the temperature unstable gamma-aluminum oxide is only partially reacted with carbon and nitrogen to form both alpha-aluminum oxide and aluminum nitride;

2. *A one hour soak at 1550°C. is sufficient to convert the proper amount of  $Al_2O_3$  to AlN; and*

3. A temperature of 1750°C. or up to the solidus temperature of aluminum oxynitride (2140°C.), is used for approximately 40 minutes, whereby alpha-aluminum oxide and aluminum nitride combine to form cubic aluminum oxynitride.

THUS, if one followings the teaching of the combination of Maguire and Serpek or Feeco.com webpage on Rotary Kilns, it would appear that one would first only partially react the with carbon and nitrogen to form both alpha-aluminum oxide and aluminum nitride in a rotary drum operating at one temperature range, then remove the alpha-aluminum oxide and aluminum nitride from the drum to allow "*A one hour soak at 1550°C. is sufficient to convert the proper amount of  $Al_2O_3$  to AlN*"; and finally introduce the post soaked AlN into a rotating drum operating at a different, higher temperature range to convert the AlN into aluminum oxynitride.

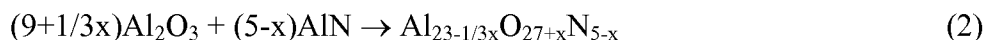
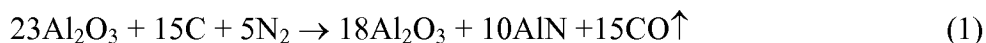
Thus, Maguire does not recognize, and in fact, by teaching that aluminum oxynitride requires the steps of heating, soaking, heating, teaches away from producing aluminum oxynitride by merely introducing aluminum oxide particles and carbon particles into a rotating drum and coming out with aluminum oxynitride. Or, as stated in claim 34: (a) providing a chamber;(b) introducing aluminum oxide particles and carbon particles into the provided chamber; (c) reacting the aluminum oxide particles and carbon particles introduced into the provided chamber with nitrogen, comprising: mixing the aluminum oxide particles and carbon particles within the provided chamber; passing nitrogen gas over the mixing aluminum oxide particles and carbon particles; passing nitrogen gas over the mixing aluminum oxide particles and carbon particles with the mixing aluminum oxide particles and carbon particles being at a temperature maintained constant during conversion of the aluminum oxide particles, carbon

particles and nitrogen into the aluminum oxynitride; and (d) removing the aluminum oxynitride from the chamber, as set forth in claim 34.

With regard to the rejection of claims 8, 10-11, 13 and 32-83 under 35 USC 103(a) as being patentable over Applicant's admitted Prior Art alone or in view of Serpek optionally in view of Feeco.com webpage on Rotary Kilns, the Background section of the subject patent application describes a process where first aluminum nitride is produced (equation (1)), and then the produced aluminum nitride is reacted with a proper amount of alumina to produce ALON (equation (2)).

As stated in the Background section:

ALON can be synthesized by a process sometimes called carbothermal nitridation. Generally, in this process, alumina ( $\text{Al}_2\text{O}_3$ ) is mixed with carbon (C), and this mixture is reacted under a nitrogen-containing atmosphere, e.g., dinitrogen ( $\text{N}_2$ ), at high temperatures, e.g., about 1650-1850 °C. The specific reactions that occur in the process are represented in equations 1-2.



As shown in Equation 1, a portion of alumina, carbon, and nitrogen react to form aluminum nitride, and carbon monoxide gas is produced. This reaction can occur at about 1650-1750 °C. The formed aluminum nitride then reacts with alumina, e.g., at about 1750-1850 °C, to form ALON. Synthesis of ALON by carbothermal nitridation, e.g., by conventional batch processing, can take up to about 20 to 30 hours to complete.

Thus, the background section describes a process wherein a portion of alumina, carbon, and nitrogen are first reacted with the drum operating at a **first temperature range** of about 1650-1750 °C. to form aluminum nitride. The formed aluminum nitride then reacts with alumina with the drum operating in a **different, higher temperature range**, e.g., at about 1750-1850 °C, to form ALON. **Two different temperature ranges** are used in the two-step process.

As stated in claim 32, the process included reacting the aluminum oxide particles and carbon particles introduced into the provided chamber with nitrogen, comprising: mixing the aluminum oxide particles and carbon particles within the

provided chamber; passing nitrogen gas over the mixing aluminum oxide particles and carbon particles; passing nitrogen gas over the mixing aluminum oxide particles and carbon particles with the mixing aluminum oxide particles and carbon particles being *at a temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride.* In fact because the process in the Background section describes *using two different temperature ranges*, it is respectfully submitted that the process described in the background section teaches away from having the *temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride.*

It is first noted that background section does *not describe* the mixing aluminum oxide particles and carbon particles; passing nitrogen gas over the mixing aluminum oxide particles and carbon particles with the mixing aluminum oxide particles and carbon particles being *at a temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride* as in claim 32. In fact, as noted above, because the process in the Background section describes *using two different temperature ranges*, it is respectfully submitted that the process described in the background section teaches away from having the *temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride.*

Further, it *is not inherent* from the description in the background section that the AlN and AlON be produced with *a temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride* as in claim 32. In fact, as noted above, because the process in the Background section describes *using two different temperature ranges*, it is respectfully submitted that the process described in the background section teaches away from having the *temperature maintained constant during conversion of the aluminum oxide particles, carbon particles and nitrogen into the aluminum oxynitride.*

THUS, if one followings the teaching of the combination of the Applicant's Admitted Prior Art and Serpek or Feeco.com webpage on Rotary Kilns, it would appear that one would first react a portion of alumina, carbon, and nitrogen in a rotary drum to

form aluminum nitride in a rotary drum operating in a first temperature range, remove the formed aluminum nitride from the drum so that it could be introduced into the same or a different drum now operating at a different, higher temperature range convert the AlN into aluminum oxynitride.

For the reasons set forth in detail above, neither Maguire nor AAPA describe nor recognize, and in fact, by teaching that ALON requires a two step processes (i.e., first aluminum nitride is produced (equation (1), and then the produced aluminum nitride is reacted with a proper amount of alumina to produce ALON (equation (2)), *teaches away from*, producing aluminum oxynitride by merely introducing aluminum oxide particles and carbon particles into a rotating drum and coming out with aluminum oxynitride.

*New claims 89 -92 have been added. Claim 89 points out that the method includes: (c) heating the mixing reaction mixture at a constant temperature of between 1700°C and 1900°C for between 10 minutes and 30 minutes while nitrogen gas flows over the mixing reaction mixture to convert the aluminum oxide particles, carbon particles, and nitrogen to aluminum oxynitride; and (d) removing the aluminum oxynitride from the chamber. This step is not described in either Maguire or AAPA.*

*Claim 90 points out that wherein the mixing reaction mixture provided in step (b) of claim 89 has an initial temperature, the method further comprising heating the mixing reaction mixture to raise the initial temperature from the initial temperature to the constant temperature.*

*Claim 91 points out that the temperature is ramped from the initial temperature to the constant temperature.*

***Claim 92 points out that the ramp rate is at least 10 degrees C per minute.***

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Respectfully submitted,

<u>February 27, 2007</u>	<u>/richard sharkansky/</u>
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